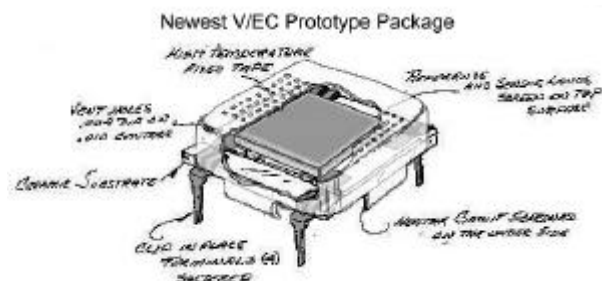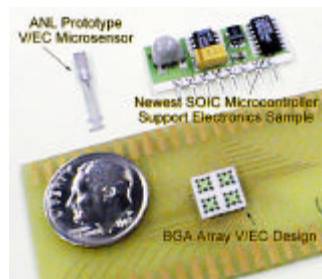# ANL's Voltammetric/Electrocatalytic (V/EC) Gas μicrosensor Technology

**V/EC Microsensor Package Design**
(stamped metal enclosure)

**Prototype SIP V/EC Sensor, Sample Electronics Package (S-SEP)
Dime (for scale) and BGA V/EC Array Sensor Design**

ANL's V/EC gas microsensor represents an integrated-technology product. It employs neural processing algorithms to identify and quantify electrical signals (gas signatures) generated by applying cyclic voltammetry to a solid cermet film sensing device. The device has shown the capability to be trained to detect different gases with advanced materials also being developed to tailor its selectivity to subsets of gases. The device and measurement technique have been awarded patent(s), with research continuing to further miniaturize the device, improve its operating characteristics, *operate in real-time*, and produce a room-temperature, ultra-low-power device.

| Microsensor Element Current Capabilities	Support Electronics Current Capabilities
100° - 500°C current operating range with potential for > 1000°C operation	ms processing time
1-30 second programmable sampling time	palm-sized test and support electronics
±5% Accuracy	< 10$ Component cost
detection of more than 15 different gases from concentrations of 1 ppm - 100% and proof of concept detection of gas mixtures.	Standardized analog or digital output
> 5-year microsensor life	single microcontroller IC support
< 25¢ per sensor commercial production cost	5-12 V DC battery operation

Prototype V/EC Analytical Instrument
(Printed Circuit Board + Notebook Host)
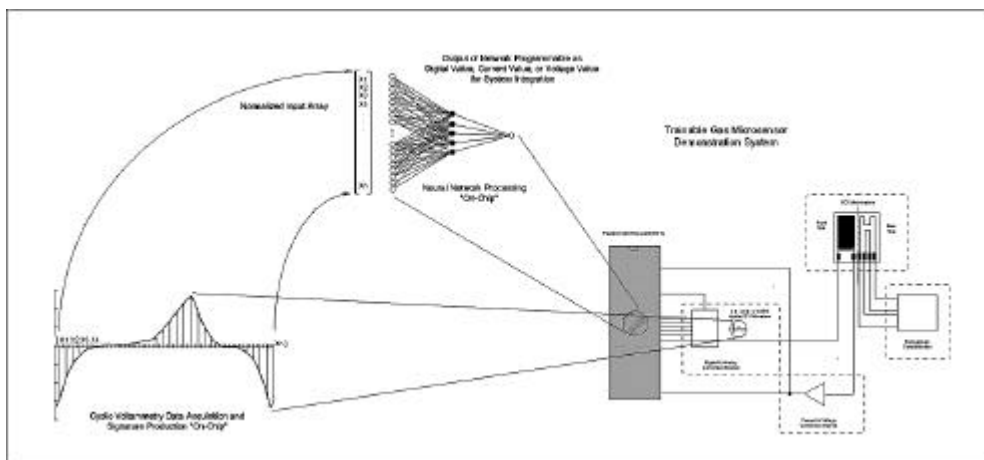
System Operation Diagram
(On-chip cyclic voltammetry and neural processing
to support catalytic cermet sensor)

ECG microsensor detectable gases and vapors to date.			
methane (> 0.1%)	methanol (> 100 ppm)	oxygen (> 100 ppm)	ammonia (> 100 ppm)
methylene chloride (> 100 ppm)	chlorine (> 10 ppm)	carbon monoxide (> 10 ppm)	hydrogen sulfide (> 10 ppm)
benzene (> 10 ppm)	propane (> 1 ppm)	carbon dioxide (> 0.25%)	formaldehyde (> 10 ppm)
ethanol (> 10 ppm)	toluene (> 10 ppm)	nitric oxide (> 1 ppm)	chloroethylethylsulfide (CEES) (< 100 ppm)
xylene (> 5 ppm)	acetone (vapor test)	dichloroethane (vapor test)	di-isopentylsulfide (DIPS) (< 100 ppm)
dichloromethane (vapor test)	isopropyl alcohol (vapor test)	smoke (vapor test)	

() Represents lowest concentration tested.   Most gases can be detected from their lower limit to 100%.
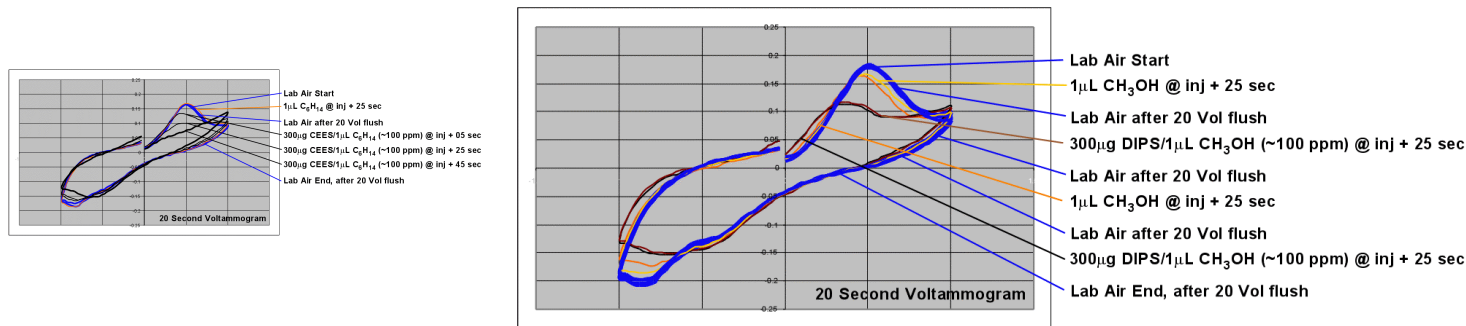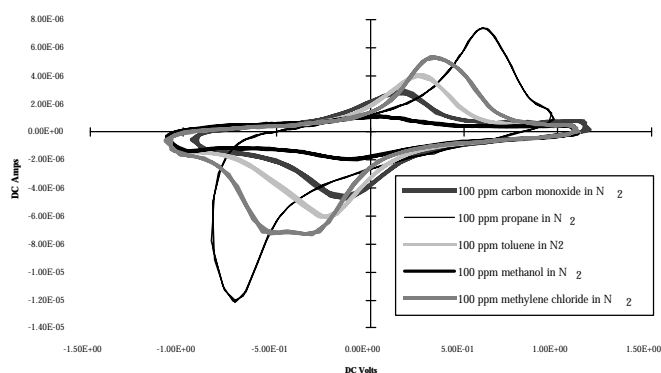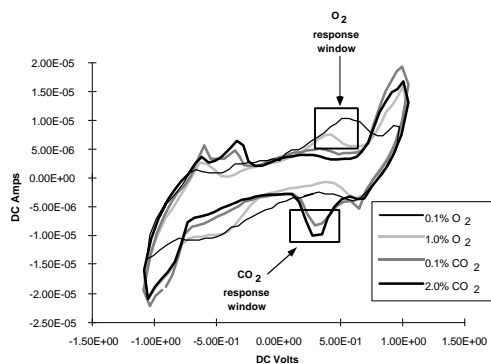

EC sensor response to chloroethylethylsulfide.
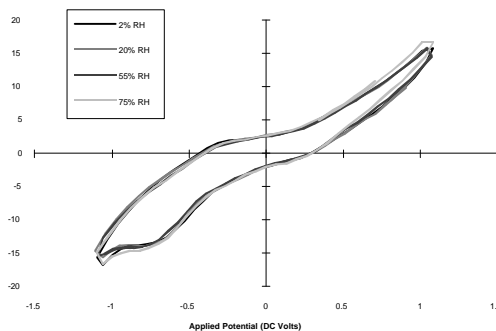

EC sensor response to di-isopentylsulfide .
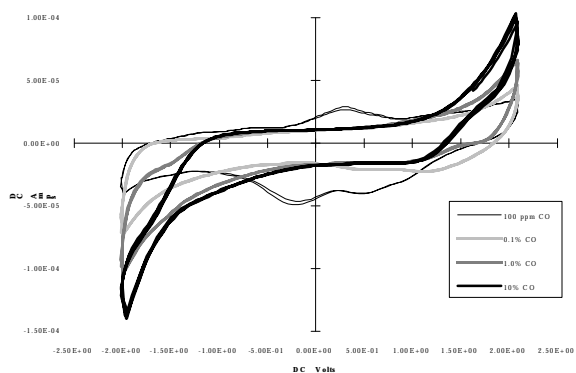
EC sensor response to carbon monoxide

EC response to various hydrocarbons demonstrating multi-gas response capability.

EC response to O$_2$ and CO$_2$ demonstrating selective response windows.

EC sensor response to humidity.
The signal does not change or drift with increased humidity.

For more information contact ANL's Energy Systems Division, Center for Environment Restoration Systems 630/252-5608